BAY-510

Title of the Invention

RUNNING SHOES, HIKING SHOES AND BOOTS, SNOWBOARD BOOTS, ALPINE BOOTS, HIKING BOOTS, AND THE LIKE, HAVING WATERPROOF/BREATHABLE MOISTURE TRANSFER CHARACTERISTICS

Inventor

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RUNNING SHOES, HIKING SHOES AND BOOTS, SNOWBOARD BOOTS, ALPINE BOOTS, HIKING BOOTS, AND THE LIKE, HAVING WATERPROOF/BREATHABLE MOISTURE TRANSFER CHARACTERISTICS

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part application of U.S. Serial No. 09/500,535, filed February 9, 2000, which is a continuation application of U.S. Serial No. 08/910,116, filed August 13, 1997, which is a continuation-in-part application of U.S. Serial No. 08/832,800, filed April 4, 1997, now abandoned, which is a continuation-in-part application of U.S. Serial No. 08/747,340, filed November 12, 1996, now U.S. Patent No. 5,738,937, and claims priority to U.S. Provisional Applications 60/330,477 and 60/330,478, both filed on February 26, 2003. The entire disclosures of all of these applications are hereby incorporated by reference. In addition, the entire disclosures of pending applications U.S. Serial No. 10/600,711, filed June 23, 2003 and U.S. Serial No. 10/757,454, filed January 15, 2004, are also hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to a variety of shoes and boots used in a variety of applications. For example, the present invention may be employed in a variety of applications including running shoes, lite hiking shoes and hiking boots, snowboard boots, alpine boots, and the like. The shoes and boots are breathable and waterproof to increase comfort for the runner, hiker or rider, etc. These shoes and boots include liner that transfer moisture in a way never before accomplished in the prior art.

BACKGROUND OF THE INVENTION

Various types of liners are known from the prior art. However, these liners do not provide the advantages realized by the present invention. The present inventor has recognized the problems faced by runners, snowboarders, skiers and hikers and developed shoes, boots and liners to overcome such problems.

There is an on-going need for comfort, breathability, and support for running shoes, snowboard boots and alpine boots and linings therefor. In prior designs, a rigid, non-breathable outer material, such as vinyl, foam, and nylon is often used. The inner liners have been leather, synthetic leather, nylon, or polyester blends which extremely limit the ability to breathe or wick moisture away from a runner or rider's body. These materials have prevented the foot from breathing adequately.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a first portion of the liner according to a first embodiment of the present invention.

Figure 2 illustrates a second portion of the liner according to a first embodiment of the present invention.

Figure 3 illustrates an example of the liner according to the first embodiment of the present invention.

Figure 4 illustrates the liner shown in Figure 3 which will form a part of a running shoe, snowboard boot or alpine boot liner.

Figures 5(a) and 5(b) illustrate a sole portion of a liner constructed according to a preferred embodiment of the present invention.

Figures 6 and 7 illustrate a tongue portion of a shoe or snowboard boot constructed according to the first embodiment of the present invention.

Figure 8 illustrates a more detailed view of the liner portion used for the tongue of Figures 6 and 7.

Figure 9 illustrates a portion of the liner used in the upper cuff area.

Figure 10 illustrates the travel of moisture through a reticulated foam, then a flexible mesh, into and through a breathable membrane according to the first embodiment of the present invention.

Figure 11 illustrates the toe portion of a shoe, snowboard boot or alpine boot according to a preferred embodiment of the present invention.

Figure 12 illustrates an overall drawing of a snowboard boot, soft alpine, alpine or hiking boot which will incorporate the liner of the present invention.

Figure 13 illustrates an overall drawing of a running shoe.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description of the preferred embodiments of the present invention is undertaken in connection with the drawings. This description, while undertaken with respect to the disclosed embodiments, is intended to enable a variety of different applications and slight modifications which form a part of the present invention. More specifically, many of the materials used in this lining system have been developed relatively recently, and in many cases are still being modified and improved. Where possible, tradenames of specific products have been used to assist in the understanding of the invention. The lining system according to the present invention can be easily adapted

to accommodate further developments in these materials. For example, while the preferred embodiments are illustratively presented below as a specific sequence of layers, it should be understood that one or more of these layers may be omitted depending upon the specific needs of any application. In other words, it is not strictly necessary to have a certain number of foam layers just as that disclosed in the currently preferred embodiment. This also applies for the other elements that are described. For the sake of conciseness, every possible combination contemplated by the inventor is not specifically enumerated. With this in mind, the preferred embodiments currently envisioned are set forth below.

Figure 1 illustrates a portion of the liner, or lining system, according to a first embodiment of the present invention. This embodiment is directed to a liner for a running shoe which is generally non-removable or for a snowboard or alpine boot which is generally removable. The liner may be non-removable in some embodiments. The various layers of materials discussed below can be attached to one another in a number of ways, particularly by lamination, mechanical bonding (or stitch bonding such as that done by Tietex, Inc. or XYMED GROUP by DuPont®) or Foss Manufacturing, or the like, or a combination of lamination and mechanical bonding. Mechanical bonding can be performed using nylon, polyester, spandex or LYCRA® thread, or the internal fibers in the nonwoven base. In some embodiments the mechanical bonding pulls the internal fibers from a bottom layer to attach the fibers in the above layers. As shown in Figure 1, a first foam or foam and nonwoven composite material (20) is provided between an inner liner (10) and a nonwoven attached to a second foam material (30). The inner liner (10) can be attached to the first foam or material (20) by lamination, ultra sonic bonding or the

like. The second foam material (30) is a germicidal, reticulated and/or open cell foam and has a thickness of approximately 1/20 to 1/4 inch. All of the foam materials used in the present invention are assumed to be breathable and their thickness can be varied depending upon specific needs. Alternatively, some of the foam materials can be replaced with a germicidal, hydrophilic open-cell foam. For example, a foam called AQUAZONE or VPF (made by FOAMEX) may be used. Preferably, the AQUAZONE or VPF is attached to a non-woven top sheet made of wool, wood pulp, polyester, cotton, rayon, polypropylene, LYCRA®, spandex, lyocel, acetate or a combination of these, etc. Alternatively, the inner lining or the first foam layer maybe attached cellular elastomeric composite. In a number of performance catagories, the first layer fabric abuts a nonwoven, nonwoven and foam, or the cellular elastomeric and then the selected performance exterior shell fabrics. These light weight composites are used for side walls and uppers in running shoes, lite Hiker or the cross country shoes and for tongues and gussets in the hiking, or alpine boots .

The inner liner (10) is preferably constructed using specific fabrics possessing certain desired characteristics. A list of fabrics which can be employed depending upon the individual needs of their application as well as the individual needs of each runner or rider is provided below. These fabrics may either be used individually or in combination and can be double sided with one fiber on one side and another on the other side. Variations for use in a running or hiking shoe, snowboard or soft alpine or shell boot or liner are specifically recited.

All polyester or polypropylene fabrics made by Coville, Inc. or Deercreek Fabrics are treated with TRANSPOR DRY FIBER TECHNOLOGY, a wetting solution or the like.

The second fabric is an anti-microbial, anti-fungal polypropylene fleece having a polyester, cotton, acrylic rayon or wool backing, or the like (such as that manufactured by Coville, Inc.) This double sided fabric combines two moisture management mechanisms, wicking and absorption. The wickable synthetic fiber pushes the moisture away and the cotton, rayon etc. pulls the moisture up from the inner layer and spreads it out for transfer and evaporation. This double sided fabric may be used for winter hiking or climbing boots and various alpine boots, the backing made of polyester or cotton blends can be replaced with either natural or synthetic blends of fibers such as wool, cotton, silk, acetate, acrylics, tencel, rayon, polyester, corn or kapok fibers or the like.

The third inner lining material may be a nonwoven such as that made by Freudenberg called Vildona or Evolon made from microdenier polyester, nylon synthetic blends or nonwovens made of natural fibers and natural fiber blends such as cotton, kapok, wood pulp and by-products such as those by NatureWorks called (PLA)CORNUCOPIA made from a corn fiber.

The fourth fabric is an anti-microbial, anti-fungal polypropylene/cotton blend with ALPHA fiber (such as that manufactured by Intex Fabrics, Inc. or the like).

The fifth fabric is a FIELDSENSOR polyester with waffle weave construction (such as that manufactured by Toray and distributed by Yagi & Co., Inc.). Alternatively, a polyester material known as AQUA-DRY, manufactured by Teijin Shojin can be employed.

The sixth fabric is a hydrophilic anti-microbial DRI-LEX BABY KID, DRI-LEX nylons or perforated material (such as that manufactured by Faytex Corp.)

The seventh fabric is a polyester looped terry (such as that manufactured by Kronfli Spundale Mills, Inc.).

The eighth fabric is a sueded/sanded fleeced polyester microfiber material (distributed by Yagi & Co., Inc. and Teijin Shojin, Inc.).

The ninth fabric is POLAR TEC SERIES 100, 200 and POLARTEC POWERSTRETCH which is a wickable, moisture transfer fiber, containing LYCRA and polypropylene. This fabric is also anti-microbial.

The tenth fabric is a moisture transfer fabric CERAMIC FLEECE by Calamai.

The eleven fabric is a wool blend with a cotton, polyester, or the like backing.

The twelfth fabric is an acrylic-based conductive fabric from Sterling Performance.

The thirteenth fabric is a nylon or nylon polyester blend possibly treated with TRANSPORT DRY FIBER technology manufactured by Gilford Mills .

The fourteenth fabric is a spacer fabric constructed of nylon, polyester, or polypropylene blend.

The fifteenth type of fabrics are selected chemical and naturally ionized synthetic fabrics and fibers such as (MICROSAFE ACETATE, MICROSUPREME ACRYLIC CYSTAR, BIOFRESH and the like manufactured by Celanese Acetate, Sterling Performance Fabrics, MICROSUPREME HIGH TECH ACRYLIC by Sterling Performance fabrics.

The sixteenth type of fabrics are ACRILLIAN or DURASPUN acrylics performance fabrics by Monsanto or blends of acrylics and polyester by Glenoit, or the like.

The seventeenth fabric is blend of performance fibers and TEFLON or FREELON blend of Friction Free Technology by Concept III.

The eighteenth fabric is a new blend of corn fabrics or corn and cotton fibers with wool by Draper Knitting.

The nineteenth fabric is peppered fleece a combination of cotton, acrylic or cotton, acrylic and polyester

The twentieth fabric is KWILL fleece by Concept III.

The twenty-first fabric is K-WICK by Kronfli Spundale Mills.

The twenty-second fabric is MICROLANA MICROFABRIC by Glenoit.

The twenty-third fabric is MICROSUPREME HIGH TECH ACRYLIC by Sterling Performance Fabrics blends of acrylic, cotton and polyesters fleeced fabrics.

The twenty-fourth fabric is NANO-DRY by Nan-Tex, a blend of cotton and synthetics.

The twenty-fifth fabric is DRI-RELEASE by Concept III Textiles.

The twenty-sixth fabric is by Dyersburg called DYERTECH.

The twenty-seventh fabric is DRYLINE by Milliken a hydrophobic polyesterand LYCRA.

The twenty-eighth is SWEET a polyester fabric by Tapetex.

The twenty-ninth is a polyester and polypropylene fabric blend by Coville, preferably COMFORTREL. Also preferred are moisture transfer knits by Coville and blends of cotton and polyester and/or polypropylene, preferably HIGHLANDER-PLUS or POLYGON STRETCH.

The thirtieth fabric is cross-dye POWER DRY and SMART FIBER fabrics by Wellman.

The thirty-first fabric is MICROMOVE by Burlington.

The thirty-second are polyester fabrics and blends by Kronfli.

The thirty-third is M.C.S. WITH NANO DRY.

Thirty- fourth, spacer fabrics or fleeced fabrics of polyester or polyester blends manufactured by Malden Mills and others can be used.

The thirty-fifth fabric is a hydrophilic anti-microbial DRI-LEX BABY KID or perforated material (such as that manufactured by Faytex Corp.).

The thirthy- sixth fabric is a polyester looped terry (such as that manufactured by Kronfli Spundale Mills, Inc.).

The thirty-seventh fabric is a sueded/sanded polyester microfiber material (distributed by Yagi & Co., Inc. and Teijin Shojin, Inc.).

The thirty-eighth fabric is the POLAR TEC Series 2000, which is a wickable, moisture transfer fiber, containing LYCRA® and polypropylene. This fabric is also anti-microbial.

The thirty ninth fabric is a moisture transfer fabric by Tietex, Inc.

The forty fabric is wool or a wool blend with a cotton, polyester, or the like backing. Double faced knitted fabric

The forty-first fabric is nylon or nylon polyester blend treated with or without transfer dry fiber technology manufactured by Guilford Mills or a nanotechnology fabric by Burlington Mills..

The forty-second fabric is a spacer fabrics constructed of nylon, polyester, polyester or polypropylene blends manufactured by Malden Mills or Deercreek Fabrics or the like.

The forty-third fabric is a polypropylene, polyester or acrylic blends. Chemically ionized synthetic fabrics by Sterling Fiber.(CYSTAR AF ECT.)

The forty-fourth fabric is acrillon or DURASPUN acrylics fabrics by Monsanto.

Forth-fifth fabric is an acetate blend.

Forty- sixth fabric recommended is DRILINE by Milliken & Co.

Forty-seventh is DRYWICK by Adidas, DRI F.I.T. by Nike, DRYLINER by Insport, DRY-LEX by Faytex or Faytex moisture moving fabrics or composite fabrics.

Forty-eighth fabric is HYDROMOVE developed by Reebok International

Forty-ninth is HYDRASUEDE by Insport,

Fifty fabric M.C.S. by Burlington Mills,

Fifty-first is NATUREXX

Fifty-second fabric group is the POLARTEC 100 series bi polar by Malden Mills,

Fifty-third fabrics are QUICK WICK Collection by Summit Knitting.

Fifty-third material is nonwoven, nonwoven and foam composite or a spacer fabric.

All synthetics and natural fibers and fabrics may have the option to be treated with Nanotechnology, Transpor Dry Fiber Technology, Chemical Inoization , Phase Change Technology or wicking solutions. The addition of the Phase Change Technology to melt blown fiber is presently marketed by OUTLAST as THEMOCULE or by Freundenberg Nonwoven. The OUTLAST/DTI melt-blown spun bond fiber, Freudenberg Nonwoven thermal fibers with Phase Change, THERMOLITE, THINSULITE ot THERMOLITE or THINSULITE with Phase Change Technology or ThemoSense by Wisconsin Global Technology is an option in any layer in MVT system. The fibers, nonwovens, fabrics may be further treated with NANO-TEX or NANO-DRY or be chemically ionized.

All of these fabrics have good moisture transfer characteristics which prevent damage to a runner or rider's foot by preventing excessive moisture build-up.

The moisture transfer characteristics of the inner liner (10) causes moisture vapors to pass from a runner or rider's body through the inner liner (10) where it then comes into contact with the first foam, nonwoven or nonwoven and foam composite material (20). The moisture vapors travel through the first foam, nonwoven or nonwoven and foam composite material (20) and come into contact with the abutting nonwoven or second foam material (30).

The first foam material (20) may be a cellular elastomeric composite (as described in U.S. Patent No. 6,074,966 the disclosure of which hereby incorporated by reference), or the like. The cellular elastomeric composite is formed in one process and is developed by Foxrun Technology. Layer 20 is a 1/20" to 1/8" germicidal, reticulated foam (or germicidal, hydrophilic flexible polyester, open-cell foam such as AQUAZONE or VPF, Or the like) backed with a non-woven top sheet comprised of wool, wood pulp, rayon, cotton, polypropylene, lyocel, polyester, LYCRA®, spandex, or a combination there of or the like. The elastomeric composite is comprised of natural or synthetic fibers or a blend fibers hydroentangled or fused together with a liquid polymer or foam base.. The cellular elastomeric may be alternative used in the running shoe or lite hiker as a first layer material and may be combined with a spacer fabric, nonwoven or a composite of nonwovens and foam.

Optionally, Layer 20 may be a spacer fabric in some performance categories such as a cross country ski shoe or bouldering shoe and may abut and inner lining fabric or material on one side and an another foam layer or the outer shell fabric on the other side . This all-in-one MVT composite is flexible, easily molded and breathable.

All composite nonwoven and foam layers may incorporate anti-microbial silver fibers in the MVT system.

Alternatively, foam material 20 can be a frothed foam and nonwoven layer combined in one process or a foam that is separate from the non-woven top sheet and is attached to the non-woven top sheet by lamination, stitched, or ultrasonically bonded. The non-woven top sheet (when used) abuts the next layer of 1/20" to 1/4" reticulated/hydrophilic flexible polyester, open cell foam, or second foam material, nonwoven, nonwoven composite or spacer fabric 30. The second foam material 30 may also be a germicidal, hydrophilic, open cell 1/20" to 1/4" foam, such as AQUAZONE or VPF or the like. The second foam material is preferably backed with a non-woven top sheet as mentioned above. In fact, any of the foam materials discussed herein can be backed by such a non-woven top sheet or include a layer of nonwoven fibers. In fact the running shoe, hiking shoe, snowboard boot, soft alpine boot and shell boot or liner may utilize the same composites in varying constructions to transfer moisture vapor. The composite system combines multiple layers of foams and nonwovens in numerous locations to absorb, move and transfer moisture. This foam composite creates a one-way system that allows moisture to travel only in an outward direction. Also, many of the foam and nonwoven materials are interchangeable depending upon specific needs. The laminated foam and nonwoven layers may alternatively be combined with a dot matrix and flame laminated or ultrasonically bonded

to a non-woven with or without apertured top sheet of wool, cotton, bamboo, nylon, lyocel, polypropylene or polyester, silver fibers or a blend thereof, for example. The nonwoven top sheet may also be coated with a frothed foam or may have a polymer dot matrix or web applied to the surface The dot matrix is a carrying polymer agent that incorporates additives such as silca or a phase change material (which have reversible enhanced thermal properties).

For example, the first foam layer 20 may also be substituted with a germicidal, hydrophilic open-cell, 1/20" to 1/8" foam, such as AQUAZONE or VPF or a frothed open cell foam. The foam can also be backed by non-woven top sheet or may include nonwoven fibers .The nonwoven fibers may be shaped and /or hollow to increase moisture transfer and wicking properties. The nonwovens fibers may be further developed with Phase Change Technology .In fact any fiber, nonwoven or fabric may include Phase Change Technology in the system. Also, a temperature regulating membrane or coating called Outlast, by Gateway Technologies can be inserted between inner layer 10 and the first foam material 20, or applied to the fibers of layer 10.A dot matrix or a web with Phase Change can further be applied to back of the inner material or fabric and may be developed by Outlast, Schoeller, Freudenberg or the like.

Alternatively, Phase Change Technology can be applied or embedded by Frisby Technologies, Schoeller Textiles, Outlast technologies, Invista or Freudenberg in the first open cell flexible polyester, hydrophilic foam layer 20 or placed in the second foam material 30 or nonwoven or nonwoven composite layer. The hydrophilic foam is preferably AQUAZONE or VPF, but may be a Frisby or Schoeller product called COMFORTEMP, PCM or the like produced by Outlast or Invista.

The outlast membrane or coating or the frothed foam with PCM can be placed on the other side of the foam, nonwoven, nonwoven composite or non-woven top sheet, if present. In fact, phase change technology by Outlast, Frisby, Freudenberg, Schoeller or Invista, or the like may be combined with any foam, nonwoven or insulative layer and can be on either side.

A number of patents have been issued to Triangle Research & Development Corp. disclosing details related to the processes now being employed by Gateway Technologies and Frisby. For example, U.S. Patent Nos. 4,756,958 and 5,366,801 are directed to fibers and fabrics with reversible enhanced thermal properties, respectively. The disclosures of these two patents are hereby incorporated by reference. Other patents assigned to Triangle Research & Development Corp., that are related by subject matter and have overlapping inventorship, include U.S. Patent Nos. 5,415,22; 5,290,904; and 5,244,356. These patents are also hereby incorporated by reference.

Another patent, U.S. Patent No. 5,499,460, which has overlapping inventorship with the above-mentioned patents, is directed to a moldable foam insole with reversible enhanced thermal storage properties. The disclosure of this patent is hereby incorporated by reference, and is illustrative of one type of moldable foam that can be used as mentioned herein.

The nonwoven may as well by treated with a thermal enhancing technology by Wisconsin Global Technologies or Nanotechnology. Nanotechnology may be used in any portion of this invention and may be incorporated with shaped or hollow fibers and Nanotechnology. All fibers and foam in this MVT system may be treated with chemical ionization to increase the MVT performance criteria.

As shown in Figure 2, a third foam material 50, which provides support and has similar characteristics to the second foam material 30, allows the moisture vapors to continue their movement toward the outside. This third foam material 50 may be a foam, a nonwoven or spacer fabric, or combination thereof, is formed in certain areas to take necessary shapes such as the shape of an ankle, heel cup and foot bones, and is positioned so as to allow the moisture to pass through into subsequent elements, such as a waterproof/breathable membrane 70 and the outer layer 80 of the overall lining system. The outer layer 80 is preferably waterproofed by encapsulation or by using a waterproof/breathable finish or film. The third foam material 50 may alternatively be a spacer fabric by Muller or Malden or the like. The easily molded spacer fabric or the third reticulated/open cell foam material 50 can be designed to provide a well defined heel lift, and heel pocket. This invention develops the components necessary to increase technical performance with the increases support around the heel, toe, and ankle.. For snowboard boots or alpine boots, the toe box is from top to bottom, wider and more flexible than in previous snowboard or alpine boots. The laminated or mechanically bonded or welded foams and nonwovens under the heel support the runner and rider's lower back and allows for a comfortable stride. The spacer fabric when used in layers 10 to 50 is easily molded and extremely light weight and breathable. With this added comfort, the aggressive or recreational runner, hiker, rider or skier can achieve a higher level of continued performance. Spacer fabrics can be combined for improved performance with ionized foams and nonwovens.

As shown in Figure 3, between the supporting second foam material 30 and the third foam material 50 is a structural mesh 40 which can be a flex guard, for example

such as one manufactured by Naltex or Conwed or the like. that adds structural integrity to the lining system. The FLEXGUARD, by Naltex or the like may be incorporated into a thin layer of froth foam with or without synthetic and or natural fibers .Silver fivers may be include to increase the thermal and anti-microbial properties of the MVT composite. The polymer mesh similar to the spacer fabric is easily molded and flexible and adds great strengthen to the toe box, tongue or heel portion of the shoe or boot. The flexible mesh may be attached by lamination or ultra sonic bonding in some alternative performance categories for the ice boot or alpine group. A spacer fabric, moldable foam, or the like, may also be used in place of this FLEXGUARD or mesh. Also, neither may be used in some circumstances. The moldable foam, if not very breathable, can be made breathable by puncturing. Alternatively, the moldable foam can be a reticulated or hydrophilic, open-cell structure, or the like. A non-woven top-sheet (with or without apertures) can be attached to the moldable foam. If a spacer fabric or moldable foam is used, then the second foam material may be omitted. Also, the moldable foam can be AQUAZONE or VPF. Preferably, for extreme sports applications the moldable foam or spacer fabrics are used instead of the flexible mesh as layer 40.

As mentioned earlier, the material 50 is preferably similar in construction to the second foam material, namely being either germicidal, reticulated and approximately 1/20" to 1/4 inch thick, or being germicidal, hydrophilic open-cell (for example AQUAZONE or VPF). This material is preferably laminated to a non-woven top sheet (which may or may not be apertured) comprised of wood pulp, lyocel, wool, acetate, rayon, polyester. bamboo, nylon or cotton. The top sheet abuts the waterproof/breathable membrane 70 or an encapsulated or coated outer fabric.

For snowboard, alpine and hiking boots, due to the cold weather conditions, a combination of THERMOLITE(or THERMALOFT) or the like and foam mechanically bonded or laminated together, or a foam and nonwoven, or SSOFTTHERM inclusive of an open cell foam, or THERMOLITE with a spacer fabric or THERMOLITE by itself is preferably used for the third foam material 50. THERMOLITE, manufactured by DuPont®, is a thin insulation having a hollow polyester fiber laid in random layers with an acrylic binder (loose felted) needle punched through the cross section to attach layers and tie them down. Various types of THERMOLITE can be used, such as THERMOLITE EXTREME, THERMOLOFT, MICROLOFT, TFI 2000 G/M2 or TFI 4000 G/M2, etc.

Alternatively, a thermal nonwoven composite (by Foss Manufacturing) created with synthetic fibers having a open cell foam needle-punched into its internal structural layers can form layer 50, and abut layer 60, an elastomeric composite, a open cell foam, another nonwoven, a spacer fabric, another thermal product such as THERMOLITE, Foss thermal, or layer 70 a breathable membrane or layer 80 the exterior fabric or synthetic leather. The nonwoven composite is developed by mechanically bonded foam with natural and synthetic shaped or hollow fibers or a combination of these nonwoven fibers. The amount of fiber or foam in the MVT composite is determined by the selected performance criteria and the product level The fiber composition and construction depends upon the application and whether there is a need for cooling or warming. The Foss MVT thermal composite contain silver fibers. Phase Change Technology and /or Nanotectnology . The Foss composite may be next to outlast membrane, fibers or coating or have the Phase Change Technology embedded in the needled open cell foam applied.

COMFORTEMP by Frisby or Freudenberg Technology may also be needled into the existing Foss to thermal composite layer or a nonwoven with Phase change such as that made by Freudenberg or a foam or nonwoven by Schoeller with Phase change applied in incorporated into the MVT foss nonwoven composite. A dot matrix or web may be applied as well to the MVT nonwoven and foam composite surface to carry the Phase change Technology, silca particles or the like.

If encapsulation is used to waterproof the outer shell material layer 80 as discussed herein, then it is important to use THERMOLITE, THERMOLITE with foam or the Foss MVT foam and nonwoven or a Foss nonwoven called SSOFTHERM . The foss nonwoven may be comprised of acetate, polyester, acrylic or the like with or without an open cell foam needled into the base as layer 50 and 60. The thermal combinations with nonwoven fibers with or without the foam layer are used for alpine liners and hiking applications. The Foss composite may be bi-polar in nature and may contain wood pulp, cellulose or lyocel fibers. Again, the Outlast membrane, coating or Frisby, Invista , Freudenberg or Schoeller Phase Change Technology can be used in combination with the third material 50, 60, especially in condition with THERMOLITE, THINSULITE, COMFORTEMP NONWOVENS, SSOFTHERM or the like or the like.

The MVT system accommodates an ultra thin application for a running shoe and lite hiker, cross country boot . The moisture vapor continues from the second foam material 30 through the mesh or spacer material 40 and on through the third exterior foam if applied or thermal nonwoven or composite material as suggested above in layer 50 or combinations if applied in layer 60. The moisture vapors are then passed through waterproof/breathable membrane or coating if applied or the exterior shell material. The

exterior material is preferably waterproofed in most embodiments, but may not be used if the performance criteria does not require the addition of a waterproof option in the layers 70 or 80. Any layer of the MVT composite system may be eliminated to define the performance categories and levels required for the MVT breathable products. The moisture vapors are absorbed into waterproof/breathable membrane passed through to an outer layer of fabric 80, as shown in Figure 4. The waterproof/breathable membrane 70 can be selected from a variety presently available on the market. Those under the tradenames VAPEX 2000/Plus/Standard/1300, SECO-TEC, THINTECH, LAY-TEK and WITCOFLEX SUPER DRY FILM by Baxanden Chemicals (a hydrophilic membrane), and breathable membranes by Harrison Technologies are currently being considered. However, the membranes currently considered to be the preferred ones are called TX-1540 (application by Shawmut Mills). TX-1540 is intended to be an ultra-thin, skin friendly, moisture barrier that allows moisture vapors to escape while preventing outside water from penetrating. The Phase Change Technologies can be used in combination with other membranes with encapsulation techniques, or with structurally or woven knitted fibers and fabrics and can adjust to temperature changes. Of the various encapsulation techniques, the one practiced by Nextec, Toray is particularly advantageous. Nanotechnology may be applied to fibers, nonwovens and fabrics as a waterproofing and stain resistant application. Exterior shell fabrics by Schoeller or the like incorporating Nanotechnology may be utilized in layer 80 of the MVT system.

Also shown in Figure 4 is an optional protective rim or cuff 90, preferably made of a slow recovery foam (by FOAMEX, for example) a spacer product by Muller Textil or Malden or neoprene covered by spandex or LYCRA®. Cuff 90 could also be made of

a reticulated foam or a spacer fabric covered by a nylon or Kelvar material The cuff is optional in all alpine and hiking boots. A pull tab 100, preferably made of nylon, is connected to the protective rim 90. In adventure sports applications an abrasive protective material 110 is provided adjacent to a tongue 300. Another abrasive protective material 120 is provided around the heed portion of the shoe. Abrasive protective material 120 is supplied by Schoeller, DuPont®, or the like. the protective material is optional in all alpine liners.

The outer layer of fabric 80 of the lining system has 200 to 6000 denier strength and is made waterproof by a membrane, a coating, encapsulation technology or by using structurally knitted, water repelling fabrics. Encapsulation technology is being utilized by a company called Nextec, Inc. or Toray, Inc. (a Japanese company or the like). Nextec Technology can be combined with the Outlast membrane or Frisby Technology. The Outlast membrane may be coated or laminated to the outer fabric. If the outer fabric is encapsulated then the outlast technology must be applied to the fiber or fabric prior to encapsulation. The Frisby temperature regulating molecules can be incorporated into the spaces between the encapsulated fibers and may be inserted at the time of encapsulation. The breathable membranes preserve the outer layer of fabric 80 and perform as a waterproof barrier for the runner or rider's liners. If the encapsulation technology is applied to the outer layer of fabric 80, then the breathable laminate membranes need not be used.

The outer layer 80 may be any of the following materials, either individually or in combination. These materials include synthetic leathers, synthetic breathable fabrics, or the like, by Daewoo, Kevlar, and Cordura fabrics, by Schoeller, Travis or the like,

Kevlar, and technical fabrics by DuPont® and Toray. Cordura treated by encapsulation by Nectex, Toray, DuPont®, Travis, and the like, 4-ply Supplex, Cordura waterproofed by the breathable membrane, F.L. fabric by Malden Mills, DERMIZAX by Toray, ENTRANT-GIL and WAXEY by Toray, GYMSTAR PLUS and TUFLEX-HR both by Unitika. Corduras and Kelvar fabrics Schoeller, by Nam Liong and Kolon Industries. The stretch Nylon and polyester, Corduras or Kelvars fabrics or nonwoven materials can be those made by others as well. Nylon or polyester spacer meshes waterproofed by coating, encapsulation, waterproof films, membranes or by surface treatments or the fibers themselves may be engineered to repel water. There are primarily six ways of protecting outer layer 80, encapsulation, using a membrane, structurally knitting the fabric to repel water or coating the fabrics with a waterproof film or engineering fibers to repel water by defining their chemical make-up and shape. Nano technology may further develop addition polymer ribs on a filament surface to create Nano Channels allowing the moisture to travel rapidly along the channel walls. The shaped or microcrimped fibers increase the moisture movement and the hollow fibers allow the air and vapor to pass internally. Additionally some Hollow fibers may be shaped and have a further option to add the Phase Change Technology in side the hollow core of the fiber. Preferably, the outer layer 80 is a combination of one or more of the above-mentioned materials and technology. A combination of shaped fibers , hollow fibers and Nanotechnology Technologies with waterproof encapsulation technology by Nextec or Toray or the like, with or without the Phase Change Technology by Schoeller Textil, Invista , Outlast, Freudenberg or Frisby Technologics . Waterproof/breathable fabrics such as ENTRANT-GIL, DERMIZAX, TUFLEX, GYMSTAR, or the Sheller Nan fabrics or Toray shell

fabrics or the like are suggested for a hiking and alpine categories. The stretch fabrics and nonwovens in layer 80 are suggested for cross country shoes and boots and for and alpine boots and running shoe categories. The Phase change membrane, coating or fibers can be incorporated or added to the back of the outer fabric or material. Phase Change Technology may be embedded in the encapsulated outer fabric or nonwoven or the Phase Change Technology applied to a waterproof/breathable membrane, and applied to a fabric or nonwoven or combination with structurally knitted or woven waterproofed fabrics. Waterproof breathable membranes by Gore or the like can be applied to any inner ling material or fabric and abut the shell fabric in the ulta thin applications. The membrane may incorporate silver fibers , silica, nanospheres, synthetic or natural fibers, or a web or polymer mesh with or with out fibers or all these options. The membrane technology is rapidly increasing. Adjustments to detailed performance categories are require ulta thin all in one performance. The invention suggests the combination of the above additives and fibers to increase the membrane characteristics.

This invention suggest the increased function of a breathable membrane with the addition of silver fibers, chemical ionization, nanotechnology and Phase change technology in combinations of two or more. The ulta-thin, microporous synthetic films or membranes may include all of the above options. These microporous hydrophobic or membranes have millions of micro holes that allow moisture to move slowly through the footwear. The addition of the properties suggested above increase the moisture movement and dis-allowed the vapor to condense into a liquid state.

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in combination with ENTRANT-GIL, DERMIZAX, TUFLEX, or GYMSTAR, nylon supplex or cordura, polyester, Kelvar or synthetic blends or the like. The outer fabrics in several performance categories may not apply either Frisby or Outlast Technologies. The Frisby technology may also be in combination with an elastomeric technology preferable by Foxrun Technologies or abutting the outer fabric layer 80 in any of the open cell foams or a membrane by Outlast technologies may be laminated to the elastomeric composite abutting the outer fabric layer 80. In fact phase change technology by Frisby, Outlast or Wisconsin Global Technologies may be applied to any layer of elastomeric, foam or nonwoven where specified.

Elastomeric composite technology may be substituted in any area where there is a foam abutting nonwoven composite combination.

Selecting the proper materials depends upon the needs of each individual runner or hiker or rider or skier's needs. The non-abrasive fabrics used in the moisture transfer inner liner of the present invention greatly reduces the possibility of trapped moisture, thereby protecting the foot from fungus growth and any damage. The anti-fungal, anti-microbial polypropylene (polyolefin) fabrics quickly remove moisture away from the foot. Skin damage is minimized because the polypropylene fabric has a smooth, continuous surface or soft fleeced texture. This fabric also prevents bacterial build-up which can cause foot odor and fungus. Chemical ionization may be applied to polyolefin

The polyester looped terry blend is an excellent wicking fabric and can remove moisture rapidly when treated with a wetting agent or chemical ionization.

The anti-fungal, anti-microbial, DRI-LEX nylon fabrics, like the polypropylene, is sanded and soft. The material is extremely comfortable and cool to the tough. Chemical ionization can be applied to nylon and nylon blends.

The polyester field sensor fabric works well with those individuals who prefer high performance. The liner absorbs moisture immediately.

A polyester microfiber fabric is smooth to touch and wickable. A wetting agent may be added to assist in moisture transfer. Chemical ionization can be applied to nylon and nylon blends

Exterior Shell fabrics or nonwoven and foam composites or composites by Gore, Faytex , Schoeller kelvar or nylon Cordura Textiles, Nam Liong, Kolon, Toray, or the like comprised of foam, membranes, film,s nonwovens, spacer fabric or a combination of one or more may be used in the outer shell layer 80.

Schoeller Stretch Textil 400-B series textiles

Wool or wool blend preferably with polyester or nylon fibers .

Finally, a wool, cotton or polyester blend backed with polyester, acrylic or cotton or the like. Structurally knitted or woven double faced and ionized fabrics.

As a result of using this lining system, the runner, rider or hiker continues to have a cooler, drier foot. The lightweight Kevlar, STARLITE, Cordura, DERMIZAX or the like outer liner materials are twice as durable as the former heavyweight leathers, synthetic leathers and materials often used on the outer shell, functions as a flexible, high abrasive, breathable outer surface and aid in the moisture transfer and may be in combination with synthetic leathers and nylon or polyester spacer meshes products.

Figures 5(a) and 5(b) illustrate a sole portion 200 of a footbed insert. This removable footbed is constructed to remove moisture downward and out away from the runner or rider's foot. The inner lining material abuts an open cell foam laminated to a nonwoven abutting a moldable spacer product preferably by Muller Textil. In some cases the nonwoven may be removed. In extreme temperatures the Foss thermal composite constructed with SSOFTHERM and a combination of one or more synthetic fibers is preferable. The synthetic fibers that may be blended with the SSOFTHERM include a combination of polyester, acrylic, acretate, lyocell blends needled together with and open foam may take the place of the nonwoven and open cell foam combination or may abut the open cell on one side and the spacer product on the other side or the outer fabric. THERMOLITE ,THINSULITE or a nonwoven or COMFORTEMP nonwoven or the by Freudenberg like may be an option to the Foss thermal composite and may be needled together with an open cell foam. The footbed may be covered with CAMBRELLE DRI-LEX nylon or Faytex fabrics, nonwovens or composite fabrics or nonwovens, Gore fabrics, nonwovens or composite fabrics or composite nonwovens, Toray field sensor products, Schoeller composite fabrics . Malden fabrics or composite fabrics, or any one or combination of fabrics or nonwovens listed in the selected inner lining fabrics, materials or a nonwoven. The inserted hydrophilic open cell and spacer fabric composite adds support and transfers moisture downward. The bottom portion of the foam is preferably provided with a non-woven top sheet as described earlier. The heel pocked foam or spacer fabric protects the back of the heel. This cushion protector allows circulation in the heel. ComforMaxSport by DuPont®, an anti-microbial CAMBRELLE DRI-LEX nylon or fabrics by Faytex, Toray field sensor fabrics or one of the selected

moisture transfer fabrics, fabrics by Nam Liong, Kolon , or Gore, Faytex, and Scholler exterior shell composites comprise of two or more layers with a foam membrane nonwoven or a combination of two or more, covers a spacer fabric material, a slow recovery foam or molded hydrophilic foam 220 that supports the arch and insures additional comfort for a runner in some applications. This footbed insert is removable and when inserted abuts a nonwoven thermal inside the liner. BA Figures 6, 7, and 8 illustrate the tongue 300 of the shoe in more detail. The tongue is designed to add further comfort and support. As shown in Figure 8, an inner liner fabric 310 of the tongue 300 is preferably one of the other inner liner materials mentioned above, especially the field sensor by Toray, polypropylene, LYCRA® blend with INNOVA fiber, the polyester microfiber, the polyester looped terry or the fabrics by Malden Mills, looped terry polypropylene blends or, polyester by Kronfli, Miliken or the like. This inner liner fabric 310 is preferably laminated to a structural support foam 320 and nonwoven. The nonwoven abuts a moldable spacer fabric followed by the nonwoven foot bed fabric. The foot bed is preferably molded and removable. Preferably, the foam is an 1/8 inch or 1/4 inch and is germicidal, reticulated flexible polyester and open cell foam. The inner lining fabric may also be abutting an elastomeric composite or may be directly abutting a moldable spacer fabric and exterior materials. A hydrophilic open cell or perforated foam 330 (also could be a reticulated foam, or the like) abuts a structural support foam or spacer product 320. The hydrophilic perforated foam or spacer fabric 330 can take the shape of the foot bones and protect the upper foot from damage. The structural support 320 can also be shaped to accommodate the foot and protect the ankle bones. Optionally, a moldable spacer fabric by Muller, or the like, may also be used as portion 330. A

moisture transfer material 340 lies over the hydrophilic open cell or perforated foam 330. This moisture transfer material 340 is preferably made from material known as aero-spacer DRI-LEX, which is manufactured by Faytex Corp, BIRDEYE nylon by Gilford Mills treated with or without transport technology, an aero-spacer fabric manufactured by Apex Mills, or a waterproof nylon or polyester blend or the like. The abutting exterior fabrics may be either a nylon or polyester blend spacer mesh material or one of the selected exterior fabrics mentioned and can be coated with a waterproof coating. In one embodiment, the aero-spacer, exterior spacer meshes products or outer fabrics are in combinations with synthetic leathers. It should be understood that non-woven synthetic materials can always be substituted for the aero-spacer DRI-LEX, spacer mesh products even if not specifically mentioned in other parts of this disclosure. The spacer mesh or spacer fabric products 340, in some hiking applications, is wrapped around the outer edge of the tongue to allow moisture vapors traveling from the upper foot area to escape through moisture transfer material 340 to the outer surface of the tongue 300. Material 340 also aids in providing a softer edged tongue. Finally, an outer layer 350 may be added in some hiking applications over a central portion of the material 340. Another hydrophilic, molded foam (not shown), or slow recovery form, moldable spacer fabric or hydrophilic foam, is shaped to fit between the outer layer 350 and material 340. In extreme adventure sport applications the added protection may be required.

As shown in Figure 6, outer layer 350, which can be a breathable synthetic leather (by Daewoo Corp. for example) or a Kevlar, or the like is surrounded by aero-spacer DRI-LEX or a spacer fabric 340, a substitute as mentioned above or a combination thereof. At the top of the tongue 300 an abrasive reflective grip fabric may be added for

running and hiking applications (such as that manufactured by Schoeller and identified by the number 6500, or the like), also shown in Figure 4. Stitching is identified by numeral 370. Figure 7 illustrates a top portion of the tongue 300, and shows stitching 370 and the liner fabric 310.

The liners are preferably provided with a pull tab 100 as illustrated in Figures 4, 9, and 10 on the back of cuff 90 constructed of a slow recovery foam (by Rogers, or the like), moldable spacer fabric, moldable foam or foam and nonwoven composite or neoprene covered by spandex or LYCRA®. Optionally, cuff 90 can be omitted altogether. Figure 9 shows an opened up version of the liner looking from the back of the liner or hiking boot. Located just beneath the spandex or LYCRA® covered neoprene cuff , foam, nonwoven and foam composite or spacer fabric 90 is an abrasive grip fabric material 410, such as manufactured by Schoeller, Inc., Nam Liong , Kolon or the like and referred to by the number 6500. Below material 410 is a reflective grip composite material 420. An option in the hiking application is a highly abrasive fabric 110 as shown in Figure 4. Fabric 110 is preferable a Kevlar, or a Cordura, or the like. Finally, outer shell fabric 80 is the same as that shown in Figure 4, and can be any of the fabrics listed previously in connection with outer shell fabric 80. The nylon pull tab 100 allows the rider's easily entree into the liner.

Figure 10 shows the other side of the liner of Figure 9. In figure 10, 510 can be a 1/4 inch moldable foam which has been punctured or a moldable spacer fabric or the like. 520 represents the combination of the flexible mesh and foam (in case the moldable foam is not used as depicted), the outer shell fabric. As in all of the figures, the arrows depict the flow of moisture. Figure 11 illustrates the toe portion 400 of the liner. Preferably, the

toe portion 400 is constructed with an inner liner 10, followed by a foam and nonwoven composite abutting a thermal composite material 30, followed by a breathable membrane if used 60 and finally followed by the outer fabric 70. Foam material 30 can either be one layer of foam, two foams, a layered or combined foam, nonwoven, foam composite, a THERMOLITE or THINSULITE or a THERMOLITE or THINSULITE and foam combination, SSOFTHERM and foam or a Foss thermal composite and synthetic fiber blends withor without foam or any of these in combination with a non-woven top sheet (or a cellular elastomeric composite). Abrasive grip fabric is also shown. The breathable membrane is optional the shoe or alpine boot and may be omitted in a number of performance categories.

The 6500 high abrasive fabrics manufactured by Schoeller, Inc. or the like are optionally located on the back of the cuff and the top of the toe box and heel. The Kevlar and Cordura, STARLITE and Cordura fabrics provide comfort and durability to the liners and are extremely strong and resistant to abrasion and allow for breathability and performance.

Figure 12 illustrates a snowboard boot liner incorporating the lining system discussed above. The following elements of the snowboard boot are shown: numeral 610 represents a waterproof breathable synthetic leather, a Kevlar fabric (made by Schoeller, or a similar material), Schoeller, DuPont® & Toray or the like, Cordura or DERMIZAX by Toray; numeral 615 represents materials similar to that of numeral 610, but can have different colors for aesthetic purposes; numeral 630 represents a Kevlar or a material made by Schoeller, or the like, with the heel portion being synthetic rubber, EVA, or the like, manufactured by Daewoo; numeral 635 represents an inner moisture transfer

material covering a molded breathable foam or spacer fabric; numeral 640 represents a Kevlar or Cordura material; numeral 650 represents some decorative piping made of synthetic leather, stitching, polymer or the like; numeral 655 represents a pull tab made of nylon or synthetic leather; numeral 660 represents the base of the Boot which can be made of a synthetic polyurethane; numeral 670 represents a reflective Kevlar back; and finally, numeral 675 represents an optional sock that can be inserted into the boot with the permanent liner or the removable liner insert if desired.

The sock 675 is made up of three layers. The first layer can be any of the inner liner materials discussed above. The second layer is a layer of foam or thermal nonwoven such as THERMOLITE, THERMOLITE , COMFORTEMP nonwoven with foam or the Foss thermal composite with a foam needled in or a combination thereof. The third layer is a fabric such as moisture transfer polyester blend manufactured by Deercreek fabrics, Coville Inc. Fabrics , Toray or Schoeller fabrics or nonwovens, or the like. Encapsulation technology can also be applied to the third layer. This ulta thin sock layer 675 can be used for additional warmth and is removable, unlike the shoe liner and can be inserted into the all weather synthetic rubber or leather boot or a combination of leather and synthetic rubber boot, a snowboard boot, soft alpine boot or alpine shell liner. The insert is preferable used in a boot where the inner liner is not removable. The three layers can be attached to one another by lamination, mechanical bonding, stitching, ultrasonic bonding, or with an adhensive .

Figure 13 illustrates a running shoe 700 that is formed by the various combination of layers discussed above. The top portion of the shoe 700 emphasizes the various layers

that make up the shoe and should be interpreted in the context of the discussion above regarding the various options..

The microfiber technology disclosed above is rapidly developing and changing and has greatly increased the potential for improved performance of such products such as running shoes and alpine boots, provided that they are properly utilized as in the present invention. These new products are part of rapidly developing fabric technology. The present invention employs a combination of fabric, foam, nonwovens, moldable spacer materials and THERMOLITE , THINSULITE, Freudenberg COMFORTEMP nonwoven or SSOFTHERM blended layers with or without open cell foam needled into the layers, with or without breathable membranes. Breathable membranes are optional in the running or hiking shoe. Other options include structurally woven or knitted waterproof fabrics, coated fabrics, or encapsulated outer fabrics in such combinations that increase the performance of the products in which they are used as well as increasing breathability. The breathable membrane is optional in all alpine, snowboard boot, hiking applications and removable insert sock liners rubber boots or the like. While the discussion above has focused upon running and hiking shoes and snowboard and alpine boot liners, similar applications can be made with cross country boots, or in-line skates, protective gear, helmets, gloves, accessories and apparel with slight modifications. For example, in the case of a cross country ski boot, the liner would preferably have a waterproofed outer fabric, attached to a synthetic rubber base. Encapsulation technology and membranes such as TX1540, WILCOFLEX DRY combined with the Outlast technology from Gateway Technologies can be employed. It is preferable to use Outlast or Frisby close to the individual's foot in alpine, snowboard, or alpine cross country

boots. Outlast or Frisby Technologies may also be added to any of the inner lining material listed. Otherwise, the liner could be very similar, although the use of the supportive mesh could be limited to certain areas. Adjustments in the breathable membrane would be made to accommodate winter conditions and cosmetic changes could be applied to the surface areas.

The following is a brief discussion of the variations that are preferably employed for a running and hiking shoes and snowboard or alpine liners and the like. Similar names correspond to similar products discussed above and are not described in further detail.

Alpine Boots

First, a liner for alpine boots is similar to in-line skate boots with moldable spacer products and plastic mesh by Naltex used for high-performance boots. This liner would have the following layers of materials (additional drawings for these applications are omitted in order to be concise). The liner will be described in a sequence of layers beginning with the innermost layer. The first layer is selected from a group including field sensor technology by Toray, anti-microbial, anti-fungal, polypropylene INNOVA or ALPHA; DRI-LEX CAMBRELLE, or DRILEX DOE SKIN manufactured by Faytex Corp., looped poly terry by Kronfli, DRI-LEX/polyterry by Faytex, polypropylene or wool blends backed by another fiber for example cotton or wool or the like by Coville, Cordura, polyester sueded or fleeced, moisture transfer materials, or Malden Mills polyester and blends thereof, or the like. A combination of these materials may also be employed depending upon the needs of an individual skier. All fabrics may be chemical ionization.

Just in the case of the snowboard boot, the various layers can be combined by lamination, mechanical bonding, stitch bonding, ultrasonic bonding or a combination of these two. The second and third layers would include a foam that contacts the first layer and is a germicidal, reticulated foam or a hydrophilic, open-cell foam, such as AQUAZONE OR VPF, FOAMEX or COMFORTEMP by Frisby or the like. Alternatively, these layers can be a cellular elastomeric composite which is one of the above-mentioned foams backed by a non-woven apertured top sheet composed of wood pulp, polyester, rayon, cotton, or polypropylene, in a single process. A foam nonwoven, foam, nonwoven composite may also be used followed by a thermal composite if applicable.

The fourth layer is a hydrophilic, open cell(AQUAZONE or VPF), slow recovery foam or flex-guard or a polyester spacer material (by Muller) or the like for support. In this case, AQUAZONE or VPF is laminated to a flat non-woven top sheet composed of wood pulp, rayon, cotton, polyester, lyocel, polypropylene which abuts a waterproof/breathable membrane (fifth layer). If the flex-guard is used, it is followed by another layer of AQUAZONE or VPF with a top sheet abutting the waterproof/breathable membrane or the encapsulated outer fabrics. If the spacer material is used, it may or may not be molded to accommodate the foot. The non-woven top sheet may be eliminated. The spacer material will be followed by either a waterproof membrane, an encapsulated or coated fabric. The spacer material may alternatively be used in a number of the boot layers in combination with a thermal composite, foam or a foam, nonwoven composite.

The fifth layer is a waterproof/breathable membrane which may be any one of the following: Outlast membrane by Gateway Technologies in combination with SECO-

TEX, No. TX1540 (laminated by Shawmut Mills), THINTECH, VAPEX 2000/1300 standard, Laytex and ENTRANT-GIL by Toray or the like. The Outlast membrane by Gateway Technologies is in conjunction with one of the suggested breathable membranes or the like. The laminated or coated outlast membrane may also be combined with some encapsulated fibers and fabrics. The Frisby Technology may be embedded in the preceding foam or THERMOLITE or MICROLOFT by DuPont®, but is not in combination with a breathable membrane. Frisby Technology can be used in conjunction with structurally knitted waterproof fabrics, or with the encapsulation technology by Nectex, Toray or the like. Encapsulation by Nextec combined with the Outlast Technologies is preferred. If encapsulation is employed, then the fourth layer preferably includes THERMOLITE or a thermal foam composite inclusive of SSOFTHERM, a product by Foss Manufacturing, needled together with foam. If a non-removable liner is employed instead of a removable liner, a waterproof-breathable thin film can be used instead of encapsulation or a waterproof/breathable membrane.

The sixth and final layer in this removable shell liner may be Cordura, STARLITE, Tudor 3/4 ply Supplex, Kevlar fabrics, DERMIZAX or encapsulated fabric or any combination of them. Also, a waterproof breathable thin film coated fabric could be used.

ALPINE CROSS COUNTRY BOOTS

A liner for the alpine cross country boots is similar to the snowboard boot liner except the cross country boot does not have a sock liner, and the foams (or THERMOLITE and foam) are thinner. This liner would include the following. A first

layer selected from a group including polypropylene, LYCRA® or wool backed by cotton, wool, or a rayon blend or an anti-microbial, anti-fungal INNOVA or ALPHA; sueded polyester; polyester field sensor; looped polyester terry; DRI-LEX DOESKIN or BABY KID by Faytex Corp.; polyester DRI-LEX Terry by Faytex; polyester spacer fabric by Malden; and polypropylene backed by cotton by Coville.

The second layer is a germicidal open cell hydrophilic foam. It may be COMFORTEMP by Frisby or AQUAZONE or VPF with Frisby Technologies. This foam can be provided with or without a non-woven top sheet. The non-woven top sheet can be selected from any of the materials previously specified.

The third layer is a structural support foam or a moldable spacer material by Muller Textil. The foam may be a moldable hydrophilic AQUAZONE OR VPF. The heel and arch may also have a slow recovery foam or spacer product added for comfort. The thickness of the layer of foam or spacer fabric and THERMOLITE may vary for performance.

The fourth layer is a thin layer of THERMOLITE, the Foss foam thermal composite or AQUAZONE OR VPF or the like with a non-woven top sheet made of wood pulp, rayon, cotton, polyester, or polypropylene. The fourth layer may be optional in some performance categories.

The fifth layer is optionally, a waterproof/breathable membrane which may be any one of the following: SECO at Shawmut Mills, THINTECH, VAPEX 2000/1300 standard, Laytex, breathable membranes by Harrison Technologies, or ENTRANT-GIL by Toray. The outlast membrane by Gateway Technologies is employed for this layer. The outlast membrane can be used by itself, with another membrane or with

encapsulation technology on the outer fabric, such as Nextec, Toray or the like. Frisby Technology may also be applied in the open cell foam, or encapsulated outer fabrics. COMFORTEMP by Frisby Technology may be used in some applications. Alternatively, instead of the membrane, just encapsulation of the sixth layer can be performed to achieve similar results. A combination of Outlast or Frisby and encapsulation fibers or fabrics by Nextec or the like is preferred. If encapsulation is employed, then the fourth layer preferably includes THERMOLITE or the Foss Manufacturing thermal foam composite.

The sixth layer is one of the following fabrics. Note that if these fabrics are encapsulated, the waterproof/breathable membrane in the fifth layer may not be needed in combination. These fabrics include the following: Cordura; LYCRA® blends; STARLITE by Faytex Corp.; Kevlar fabric by Schoeller (14705, 6500, 13207, 13632, 65563, etc.); DuPont® and Toray or the like, Cordura 2000 by DuPont®, DERMIZAX and ENTRANT-GIL by Toray, 3 or 4 ply Supplex; Mojave and Tudor nylon and polyester blends by Travis; 6 ply Maxus nylon blends or the like; and synthetic leathers by Daewoo, Inc. or the like. These fabrics may be used individually or in combination.

The seventh layer is a LYCRA® covered neoprene, moldable spacer fabric or slow recovery foam or reticulated open cell foam ankle cuff.

The tongue for the alpine boot is similar to the tongue of the in-line skate. The tongue of the cross country boot is similar to the snowboard boot. They can be constructed of AQUAZONE OR VPF molded foams with a top sheet or moldable spacer fabrics. A slow recovery foam can also be used as specified with the snowboard boot. The inner fabric is one or more of DRI-LEX Aero-spacer, polyester field sensor by

Toray, polyester spacer by Malden, polypropylene, polar fleece, INNOVA or ALPHA or DRI-LEX DOESKIN, polyester sueded or fleeced or the like. The outer tongue fabrics are high abrasive fabrics Kevlar, STARLITE, or Schollar's Corduras, 6500, DRI-LEX Aero-Spacer (or other Aero-spacer materials by Faytex, or the like. and breathable synthetic leathers by Daewoo. or the like.

HIKING BOOTS

A liner for the hiking boot would include the following. The first layer is selected from a group including: polyester field sensor, looped poly terry, DRI-LEX by Faytex, DOE SKIN, BABY KID, CAMBRELLE by Faytex, anti-fungal, anti-microbial polypropylene fabrics, INNOVA or ALPHA, sueded polyester blends, COOL MAX or nylon blends, or the like. Any combination of these moisture transfer fabrics can also be used.

The second layer is a cellular elastomeric composite or hydrophilic open cell AQUAZONE OR VPF foam or COMFORTEMP by Frisby. The Outlast membrane is optional in this layer. If a foam is used, a non-woven top sheet selected from previously mentioned materials can be attached as a backing.

The third layer is a molded hydrophilic AQUAZONE OR VPF backed by an aperture top sheet composed of cotton, polyester, polypropylene, lyocel, rayon, or wood pulp or the like. A moldable heel and ankle spacer fabric by Muller or the like may also be used in place of the third layer of hydrophilic foam. A moldable spacer fabric or foam may be added around the toe box and back cuff. A molded heel/ankle insert by Muller Textil is preferably also used.

The fourth layer may utilize a waterproof/breathable membrane which may be any one of the following: Outlast membrane by Gateway Technologies combined with SECO-TEX, TX1540 (distributed by Shawmut Mills), THINTECH, VAPEX 2000/1300 standard, Laytex, WILCOFLEX DRY or the like. The Outlast technology may also be used independently of the breathable membrane and may also be coated to the outer fabric or fibers. Also, this membrane layer may be eliminated in some models depending upon the hiker's needs. Alternatively, instead of the membrane, encapsulation of the fifth layer can be performed to achieve similar results. If encapsulation is employed, then the third layer is preferably AQUAZONE OR VPF or a moldable spacer fabric, or THERMOLITE or the thermal Foss composite. The Outlast technology can be used in combination outer fabrics with or without encapsulation, such as by Nextec, or the like.

The fifth and last layer is a combination of one or more of the following: Corduras; Supplex Nylon; STARLITE; Tudor; Kevlar; polyester nylon blends; and breathable synthetic leathers. Preferably, this layer is waterproofed by using encapsulation, waterproof films or coatings, or breathable membranes, with or without the Outlast or Frisby Technologies.

Elastomeric composite technology may be substituted in any area where there is a foam abutting nonwoven combination.

Furthermore, the breathable liner according to the present invention could also be added to clothing such as shirts, pants, gloves, helmets, etc., by omitting elements such as the structural mesh and by adjusting the number of foam material layers and their thickness. For example, clothing preferably has a wickable inner liner, followed by an elastomeric composite or a 1/16-1/8" AQUAZONE OR VPF open cell foam which may

be embedded with or without Frisby Technologies. A non-woven may or may not be laminated to the foam. A breathable membrane abuts the foam or non-woven and is laminated to the outer fabric. The outer fabric may be encapsulated, laminated to a breathable waterproof membrane, coated with a waterproof film, or structurally woven or knitted to repel water. Indeed, the amount of foam used can be reduced due to cost consideration, etc. Presently, this liner system is using THERMOLITE , THINSULITE, SSOFTHERM, a MVT thermal nonwoven and foam composite or the thermal Ssoftherm product mechanically bonded to a needle punched composite inclusive of open cell foam and is may use a polyester spun bonded filter products by Tangerding Vlitesstoffe, Vitafiber, or the like to be used as an alternative to hydrophilic foam layers.

While the present invention has been described above in connection with the preferred embodiments, one of ordinary skill in the art would be enabled by this disclosure to make various modifications to the disclosed embodiments and still be within the scope and spirit of the present invention.